AMENDMENTS TO THE CLAIMS

Please amend the claims as they currently stand so that they are in accord with the following listing of the claims:

Claim 1 (currently amended):   A[[n]] <u>virtual reality computing</u> apparatus <s>for image data computation and for synchronous image data output</s>, comprising:

at least one signal input which is connectable to an external input unit;

a first message channel;

a graphics master unit

which has a first random access memory

adapted to receive <u>and store</u> a first scene graphics data file<u>,</u>

which <u>first scene graphics data file</u> defines objects and/or events <u>of a three-dimensional scene according to a code of a virtual reality modeling language and by means of object and/or event parameter values associated with the objects and/or events, respectively,</u>

which <s>can be illustrated in an image and</s> associate[[s]] object and event parameter values respectively with the objects and/or events,

<u>and which objects and/or event parameters are defined in the code of the virtual reality modeling language in a manner allowing a computation of partial images or of a sequence of consecutive partial images, so as to enable a three-dimensional perception of the three-dimensional scene by a human viewer by synchronously displaying the partial images as a composite image,</u>

is connected to the signal input,

is connected by way of a first message interface for incoming and outgoing messages to the first message channel

and which is adapted
to re-compute and store the object and/or event parameter values of the first scene graphics data file <u>according to the code of the virtual reality modeling language</u> in dependence on the current object and/or event parameter values thereof and on the current state of the signal input

and to produce and send a first message by way of the first message interface, wherein the first message contains at least a part of the freshly computed object and/or event parameter values <u>according to the code of the virtual reality modeling language</u>; and

at least two graphics client units, wherein each graphics client unit
has a respective second random access memory which is adapted to receive <u>and store</u> a <u>respective</u> second scene graphics data file, <u>which defines objects and/or events identical to those of the first scene graphics data file in the code of the virtual reality modeling language and by means of object and/or event parameter values associated with the objects and/or events, respectively, as received from the graphics master unit with the first message,</u>

is connected by way of a second message interface for incoming and outgoing messages to the first message channel,

has a[[n]] <u>respective</u> image data output,

and is adapted

to receive the first message comprising the re-computed current object
and/or event parameter values by way of the second message interface and
to store the received object and/or event parameter values in the respective
second scene graphics data file, thus overwriting the previously stored
respective second scene graphics data file,

to compute, after having overwritten the previously stored respective
second scene graphics data file, respective image data of a respective
partial [[an]] image of the three-dimensional scene in dependence on
current the object and/or event parameter values of the second scene
graphics data file, such that all partial images of the three-dimensional
scene computed by the graphics clients units, when synchronously
displayed together, allow a three-dimensional perception of the three-
dimensional scene by a human viewer,

to produce and send a second message to the graphics master unit by way
of the second message interface which second message signals the
conclusion of the image data computation of the respective partial image
by the respective graphics client unit,

and to output the respective image data of the respective partial image
after having sent the second message to the graphics master unit. at the
image data output.

Claim 2 (currently amended): The apparatus of claim 1 characterized in that wherein the graphics
master unit is additionally adapted to produce a third message and to send the third message to
each graphics client unit after receiving the second message from each graphics client unit and

each graphics client unit is additionally adapted to output the image data at the image data output after receiving the third message.

Claim 3 (previously presented): The apparatus of claim 2, wherein the graphics master unit has writing and reading access to a third random access memory which is connected to the second random access memory and in which at least one scene graphics data file is stored, wherein a respective memory address and/or scene graphics identification number is associated with each scene graphics data file contained in the third random access memory.

Claim 4 (previously presented): The apparatus of claim 3, further comprising:

a second message channel, associated with the graphics master unit; and

a synchronization master unit connected to the graphics master unit, having a third message interface for incoming and outgoing messages, which connects same to the second message channel, and which is adapted to produce a fourth message in which is contained the memory address of a scene graphics data file and/or the scene identification number of the scene graphics data file and to send the fourth message by way of the third message interface, associated with each graphics client unit a respective synchronization client unit connected to the associated graphics client unit, having a fourth message interface which connects it to the second message channel and which is adapted to receive the fourth message at the fourth message interface and to subsequently cause loading of the scene graphics data file defined in the fourth message into the second data memory and to produce and send a fifth message which signals conclusion of loading of the scene graphics data file, to the synchronization master unit by way of the fourth message interface.

Claim 5 (previously presented): The apparatus of claim 4, wherein the synchronization master unit and the synchronization client unit respectively are additionally adapted to produce a first test message and a second test message respectively, to produce a first test answer message after reception of the second test message at the third message interface and to produce a second

test answer message after reception of the first test message at the fourth message interface, and to send the respective test and test answer message by way of the second message channel.

Claim 6 (previously presented):   The apparatus of claim 5, wherein the graphics master unit is adapted for real-time computation of the object and event parameters and the graphics client unit is adapted for real-time image data computation.

Claim 7 (previously presented):   The apparatus of claim 6, wherein the graphics client unit and the graphics master unit are in the form of browsers for the file format VRML, Inventor, Performer and/or X3D.

Claim 8 (previously presented):   The apparatus of claim 7, further comprising:
in association with each graphics client unit, a respective graphics computing unit having a data input for image data, by way of which it is connected to the associated graphics client unit which has a signal output for control signals for controlling a display unit of an image reproduction device and which is adapted to convert image data received at the input into control signals and to output the control signals by way of the signal output.

Claim 9 (previously presented):   The apparatus of claim 7, further comprising:
a partial image switching unit for each two graphics client units, having a signal input, at least one first and at least one second image data input which are each associated with a respective graphics client unit, a first and a second image data intermediate memory connected to the first and second image data input respectively, an image data output for each pair of first and second image data inputs, which is adapted to output the image data either of the first or the second image data intermediate memory by way of the image data output in dependence on the state of the signal input, and a switching control unit which is connected at the output side to the signal input of the partial image switching unit and which is adapted to produce and deliver at least one control signal at a predeterminable signal delivery frequency.

Claim 10 (previously presented):   The apparatus of claim 9, further comprising:

a graphics computing unit which is connected to the image data output of the partial image switching unit which has a signal output for control signals for controlling a display unit of an image reproduction device, and which is adapted to convert image data received at the input into control signals and to output the control signals by way of the signal output.

Claim 11 (withdrawn):   A graphics master module comprising:

an external input unit;

at least one signal input adapted to receive signals therefrom;

a first message interface which is adapted to send and receive digitally encoded messages;

a first random access memory for receiving at least one scene graphics data file which defines objects and/or events which can be represented in an image and which associates object and event parameter values with the objects and/or events respectively;

image parameter computation means which are connected to the first random access memory and the signal input and to the message interface and which are adapted to compute object and/or event parameter values of the first scene graphics data file in dependence on the current object and/or event parameter values thereof and the current state of the signal input; and

master control means which are connected to the image computation means and the message interface and which are adapted to produce and send a first message by way of the first message interface,

wherein the first message contains at least a part of the computed object and/or event parameter values.

Claim 12 (withdrawn):   The graphics master module set forth in claim 11, wherein the graphics master module is additionally adapted to produce a third message and to send the third message to each graphics client unit after receiving the second message from each graphics client

unit and each graphics client unit is additionally adapted to output the image data at the image
data output after receiving the third message.

Claim 13 (withdrawn):   A graphics client module comprising:

a second message interface which is adapted to send and receive digitally encoded data;

a second random access memory for receiving at least one second scene graphics data file
which defines objects and/or events which can be represented in an image and associates object
or event parameter values with the objects and/or events respectively;

an image data output, and

image data computation means which are connected to the second message interface and
the second data memory and are adapted to store the object and/or event parameter values
received at the second message interface in the second scene graphics data file, to produce image
data of an image in dependence on current object and/or event parameter values of the second
scene graphics data file, to output the produced image data at the image data output, client
control means which are connected to the message interface and to the image data computation
means and which are adapted to produce and send a second message to the graphics master unit
by way of the second message interface which signals the conclusion of image data computation
of the image.

Claim 14 (withdrawn):   The graphics client module as set forth in claim 13, wherein the
graphics client module is adapted to receive a third message produced and sent by a graphics
master unit after receiving the second message from the graphics client module and the graphics
client module is additionally adapted to output the image data at the image data output after
receiving the third message.

Claim 15 (withdrawn):   An image switching module comprising:

at least one first and at least one second image data input;

an image data output, associated with each pair of first and second image data inputs;

a first and a second image data intermediate memory which is associated with the first and the second image data input respectively, which is connected on an input side to the first and second image data input respectively and adapted to store image data and to output stored image data by way of the associated image data output in response to a first and a second control signal respectively;

a switching control unit having a signal output by way of which it is connected to the first and the second image data intermediate memories and which is adapted to produce and deliver the first and second control signals in alternate sequence at a predeterminable signal delivery frequency.

Claim 16 (withdrawn):   The image switching module as set forth in claim 15 characterized in that the switching control unit is adapted for additionally delivering the first and second control signals in the form of electromagnetic radiation, in particular infra-red radiation.

Claim 17 (withdrawn):   The arrangement for producing and simultaneously reproducing at least two partial light images which together can be perceived as a light image having a three-dimensional effect, comprising:

at least one scattering surface which is adapted for polarization-maintaining scattering of light into a spatial region which in relation to light incident on the scattering surface extends either in front of or behind the scattering surface;

two light image projectors associated with a respective scattering surface as image reproduction devices, which each have a control input and which are adapted to convert a respective number of control signals received at the control input into a respective raster light image composed from light pixels in matrix form and to project the respective raster light image using polarized light, wherein the polarization of the light respectively used by each of the two projectors is oriented differently, and which are arranged to project the respective raster light image onto the associated scattering surface;

an apparatus for image data computation and for synchronous image data output as set forth in claim 8, which has in association with each light image projector a respective graphics computing unit wherein the signal output of the respective graphics computing unit is connected to the control input of the respective light image projector, and

wherein each graphics client unit is adapted to compute raster image data of a partial image, which reproduces the field of view of the left or right eye of a viewer, of an image defined by the current object and/or event parameter values of the second scene graphics data file.

Claim 18 (withdrawn):   The arrangement as set forth in claim 17 characterized in that the projectors each have a polarizer and the polarizers are transmissive for linearly polarized light with mutually perpendicular vibration directions.

Claim 19 (withdrawn):   The arrangement as set forth in claim 17 characterized in that the projectors emit right-circularly and left-circularly polarized light.

Claim 20 (withdrawn):   The arrangement of claim 19, characterized by two mutually perpendicular scattering surfaces which are adapted for back-scattering of light.

Claim 21 (withdrawn):   The arrangement of claim 20, characterized in that the scattering surfaces are metallic.

Claim 22 (withdrawn):   The arrangement of claim 21, further comprising:

a pair of analyzer spectacles for a viewer, with two lenses, wherein the lens associated with the left eye of the viewer is non-transmissive for light which is emitted by the light image projector or projectors which project the partial image for the right eye, and the lens associated with the right eye of the viewer is non-transmissive for light which is emitted by the light image projector or projectors which project the partial image for the left eye.

Claim 23 (withdrawn):   The arrangement of claim 22, further comprising:

five mutually perpendicular scattering surfaces on a floor in such a way that the scattering
surfaces and the floor delimit an approximately cubic hollow space, and by two light image
projectors for each scattering surface, which emit linearly polarized light and which illuminate
the respective scattering surface from outside the hollow space, wherein the scattering surfaces
scatter the incident light into the hollow space behind the respective scattering surface.

Claim 24 (withdrawn):   An arrangement for producing and reproducing in succession in
respect of time at least two partial light images which together can be perceived as a light image
having a three-dimensional effect, comprising:

at least one scattering surface which is adapted to scatter light into a spatial region which
in relation to light incident on the scattering surface extends either in front of or behind the
scattering surface;

at least one light image projector as an image reproduction device, which is associated
with a respective scattering surface and which has a control input and which is adapted to
convert a number of control signals received at the control input into a raster light image
composed from light pixels in matrix form and to project the raster light image and which is
arranged to project the respective raster light image onto the scattering surface;

an apparatus for image data computation and for synchronous data output as set forth in
claim 9 which has associated with each light image projector a first and a second graphics client
unit, wherein the image data output of the respective graphics client unit is connected to the first
and the second image data input respectively of the partial image switching unit, and wherein the
first and second graphics client unit is adapted to compute the raster image data of a partial
image, reproducing the field of view of the left or right eye respectively of a viewer, of an image
defined by the current object and/or event parameter values of the second scene graphics data
file.

Claim 25 (withdrawn): The arrangement as set forth in claim 24 characterized by two mutually perpendicular scattering surfaces.

Claim 26 (withdrawn): The arrangement as set forth in claim 24 characterized by five mutually perpendicular scattering surfaces on a floor in such a way that the scattering surfaces and the floor delimit an approximately cubic hollow space, and by a light image projector for each scattering surface, which illuminates the respective scattering surface from outside the hollow space.

Claim 27 (withdrawn): The arrangement of claim 17, wherein:
the light image projector or projectors are LCD or DLP projectors.

Claim 28 (withdrawn): The arrangement of claim 17, further comprising:
a PC-sound card connected to the graphics master, an audio amplifier connected to the sound card, and at least two loudspeakers connected to the audio amplifier.

Claim 29 (withdrawn): The arrangement of claim 17 comprising a first and a second flat scattering surface, wherein the planes defined by the scattering surfaces include an angle, characterized in that the first and second scattering surfaces adjoin with mutually facing edges a third flat scattering surface in such a way that the third scattering surface adjoins each of the first and second scattering surfaces at a respective obtuse angle.

Claim 30 (withdrawn): The arrangement as set forth in claim 29 characterized in that the intersection straight lines of the planes defined by the three scattering surfaces extend in mutually parallel relationship.

Claim 31 (withdrawn):   The arrangement as set forth in claim 30 characterized in that the intersection straight lines of the first and second planes with the third plane are each at the same spacing from the intersection straight line of the first plane with the second plane.

Claim 32 (withdrawn):   The arrangement of claim 31 characterized in that the first and second planes include an obtuse or a right angle.

Claim 33 (withdrawn):   The arrangement of claim 32 characterized in that the third scattering surface is of a widthwise extent of at least 60 cm.

Claim 34 (withdrawn):   The arrangement of claim 33 and an apparatus as set forth in claim 10 characterized in that each graphics client unit is adapted to compute and output in each case at least two partial image portions in such a way that a first partial image portion appears free from distortion on the first or second projection surface for a viewer from at least one position and that a second partial image portion appears distortion-free on the third projection surface from the same position.

Claim 35 (withdrawn):   A method of synchronously computing and outputting image data of at least two partial images of an image, in which the partial images are cyclically re-computed in the form of digital partial image data in dependence on image parameter values and/or current input signals and the partial image data are outputted after each computation cycle, characterized in that at the same time a master process and for each partial image a respective client process are executed,

 wherein the master process comprises the following steps:

  recomputing image parameter values in dependence on existing image parameter values and/or current input signals;

  sending at least a part of the re-computed image parameter values to all client processes;

waiting to receive readiness signals from all client processes, and

the respective client process comprises the following steps:

receiving the re-computed image parameter values from the master process, after reception of the image parameter values computation of the respective partial image in the form of digitally encoded image data,

sending a respective readiness signal to the master process, and

outputting the respective partial image.

Claim 36 (withdrawn):   The method as set forth in claim 35 characterized in that the master process additionally includes a step of sending an image change signal to all client processes after reception of all readiness signals and the client process additionally includes a step of waiting for reception of the image change signal from the master process.

Claim 37 (withdrawn):   The method of claim 36 characterized in that the image parameters are computed in dependence on the master process by externally transmitted input data.

Claim 38 (withdrawn):   The method of claim 37 characterized in that after reception of the readiness signal from all client processes the master process jumps back to computation of the image parameter values of a fresh image and after the image change the client process jumps back to receive the image parameter values from the master process.

Claim 39 (previously presented):   The apparatus of claim 1, wherein the graphics master unit has writing and reading access to a third random access memory which is connected to the second random access memory and in which at least one scene graphics data file is stored, wherein a respective memory address and/or scene graphics identification number is associated with each scene graphics data file contained in the third random access memory.

Claim 40 (previously presented):   The apparatus of claim 1, further comprising:

a second message channel, associated with the graphics master unit; and

a synchronization master unit connected to the graphics master unit, having a third message interface for incoming and outgoing messages, which connects same to the second message channel, and which is adapted to produce a fourth message in which is contained the memory address of a scene graphics data file and/or the scene identification number of the scene graphics data file and to send the fourth message by way of the third message interface, associated with each graphics client unit a respective synchronization client unit connected to the associated graphics client unit, having a fourth message interface which connects it to the second message channel and which is adapted to receive the fourth message at the fourth message interface and to subsequently cause loading of the scene graphics data file defined in the fourth message into the second data memory and to produce and send a fifth message which signals conclusion of loading of the scene graphics data file, to the synchronization master unit by way of the fourth message interface.

Claim 41 (previously presented): The apparatus of claim 40, wherein the synchronization master unit and the synchronization client unit respectively are additionally adapted to produce a first test message and a second test message respectively, to produce a first test answer message after reception of the second test message at the third message interface and to produce a second test answer message after reception of the first test message at the fourth message interface, and to send the respective test and test answer message by way of the second message channel.

Claim 42 (previously presented): The apparatus of claim 1, wherein the graphics master unit is adapted for real-time computation of the object and event parameters and the graphics client unit is adapted for real-time image data computation.

Claim 43 (previously presented): The apparatus of claim 42, wherein the graphics client unit and the graphics master unit are in the form of browsers for the file format VRML, Inventor, Performer and/or X3D.

Claim 44 (previously presented):   The apparatus of claim 1, further comprising:

in association with each graphics client unit, a respective graphics computing unit having a data input for image data, by way of which it is connected to the associated graphics client unit which has a signal output for control signals for controlling a display unit of an image reproduction device and which is adapted to convert image data received at the input into control signals and to output the control signals by way of the signal output.

Claim 45 (previously presented):   The apparatus of claim 1, further comprising:

a partial image switching unit for each two graphics client units, having a signal input, at least one first and at least one second image data input which are each associated with a respective graphics client unit, a first and a second image data intermediate memory connected to the first and second image data input respectively, an image data output for each pair of first and second image data inputs, which is adapted to output the image data either of the first or the second image data intermediate memory by way of the image data output in dependence on the state of the signal input, and a switching control unit which is connected at the output side to the signal input of the partial image switching unit and which is adapted to produce and deliver at least one control signal at a predeterminable signal delivery frequency.

Claim 46 (previously presented):   The apparatus of claim 45, further comprising:

a graphics computing unit which is connected to the image data output of the partial image switching unit which has a signal output for control signals for controlling a display unit of an image reproduction device, and which is adapted to convert image data received at the input into control signals and to output the control signals by way of the signal output.

Claim 47 (withdrawn):   The arrangement of claim 17, characterized by two mutually perpendicular scattering surfaces which are adapted for back-scattering of light.

Claim 48 (withdrawn):   The arrangement of claim 18, characterized by two mutually perpendicular scattering surfaces which are adapted for back-scattering of light.

Claim 49 (withdrawn):   The arrangement of claim 17, characterized in that the scattering surfaces are metallic.

Claim 50 (withdrawn):   An arrangement for producing and reproducing in succession in respect of time at least two partial light images which together can be perceived as a light image having a three-dimensional effect, comprising:

at least one scattering surface which is adapted to scatter light into a spatial region which in relation to light incident on the scattering surface extends either in front of or behind the scattering surface;

at least one light image projector as an image reproduction device, which is associated with a respective scattering surface and which has a control input and which is adapted to convert a number of control signals received at the control input into a raster light image composed from light pixels in matrix form and to project the raster light image and which is arranged to project the respective raster light image onto the scattering surface;

an apparatus for image data computation and for synchronous data output as set forth in claim 10, which has associated with each light image projector a first and a second graphics client unit, wherein the image data output of the respective graphics client unit is connected to the first and the second image data input respectively of the partial image switching unit, and wherein the first and second graphics client unit is adapted to compute the raster image data of a partial image, reproducing the field of view of the left or right eye respectively of a viewer, of an image defined by the current object and/or event parameter values of the second scene graphics data file.

Claim 51 (withdrawn):   The arrangement as set forth in claim 50, further comprising two mutually perpendicular scattering surfaces.

Claim 52 (withdrawn):   The arrangement as set forth in claim 50 characterized by five
mutually perpendicular scattering surfaces on a floor in such a way that the scattering surfaces
and the floor delimit an approximately cubic hollow space, and by a light image projector for
each scattering surface, which illuminates the respective scattering surface from outside the
hollow space.

Claim 53 (withdrawn):   The arrangement of claim 24, wherein:
     the light image projector or projectors are LCD or DLP projectors.

Claim 54 (withdrawn):   The arrangement of claim 50, wherein:
     the light image projector or projectors are LCD or DLP projectors.

Claim 55 (withdrawn):   The arrangement of claim 24, further comprising:
     a PC–sound card connected to the graphics master, an audio amplifier connected to the
sound card, and at least two loudspeakers connected to the audio amplifier.

Claim 56 (withdrawn):   The arrangement of claim 50, further comprising:
     a PC–sound card connected to the graphics master, an audio amplifier connected to the
sound card, and at least two loudspeakers connected to the audio amplifier.

Claim 57 (withdrawn):   The arrangement of claim 24 comprising a first and a second flat
scattering surface, wherein the planes defined by the scattering surfaces include an angle,
characterized in that the first and second scattering surfaces adjoin with mutually facing edges a
third flat scattering surface in such a way that the third scattering surface adjoins each of the first
and second scattering surfaces at a respective obtuse angle.

Claim 58 (withdrawn): The arrangement of claim 50 comprising a first and a second flat scattering surface, wherein the planes defined by the scattering surfaces include an angle, characterized in that the first and second scattering surfaces adjoin with mutually facing edges a third flat scattering surface in such a way that the third scattering surface adjoins each of the first and second scattering surfaces at a respective obtuse angle.

Claim 59 (withdrawn): The arrangement as set forth in claim 57 characterized in that the intersection straight lines of the planes defined by the three scattering surfaces extend in mutually parallel relationship.

Claim 60 (withdrawn): The arrangement as set forth in claim 58 characterized in that the intersection straight lines of the planes defined by the three scattering surfaces extend in mutually parallel relationship.

Claim 61 (withdrawn): The arrangement as set forth in claim 59 characterized in that the intersection straight lines of the first and second planes with the third plane are each at the same spacing from the intersection straight line of the first plane with the second plane.

Claim 62 (withdrawn): The arrangement as set forth in claim 60 characterized in that the intersection straight lines of the first and second planes with the third plane are each at the same spacing from the intersection straight line of the first plane with the second plane.

Claim 63 (withdrawn): The arrangement of claim 61 characterized in that the first and second planes include an obtuse or a right angle.

Claim 64 (withdrawn): The arrangement of claim 62 characterized in that the first and second planes include an obtuse or a right angle.

Claim 65 (withdrawn): The arrangement of claim 63 characterized in that the third scattering surface is of a widthwise extent of at least 60 cm.

Claim 66 (withdrawn): The arrangement of claim 64 characterized in that the third scattering surface is of a widthwise extent of at least 60 cm.

Claim 67 (withdrawn): The arrangement of claim 65 and an apparatus as set forth in claim 9 characterized in that each graphics client unit is adapted to compute and output in each case at least two partial image portions in such a way that a first partial image portion appears free from distortion on the first or second projection surface for a viewer from at least one position and that a second partial image portion appears distortion-free on the third projection surface from the same position.

Claim 68 (withdrawn): The arrangement of claim 66 and an apparatus as set forth in claim 10 characterized in that each graphics client unit is adapted to compute and output in each case at least two partial image portions in such a way that a first partial image portion appears free from distortion on the first or second projection surface for a viewer from at least one position and that a second partial image portion appears distortion-free on the third projection surface from the same position.

Claim 69 (withdrawn): The method of claim 35 characterized in that the image parameters are computed in dependence on the master process by externally transmitted input data.

Claim 70 (withdrawn): The method of claim 35 characterized in that after reception of the readiness signal from all client processes the master process jumps back to computation of the image parameter values of a fresh image and after the image change the client process jumps back to receive the image parameter values from the master process.